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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/988,685	11/20/2001	Yoshimi Shioya		9020

7590 07/31/2002
LORUSSO & LOUD
3137 Mount Vernon Avenue
Alexandria, VA 22305

EXAMINER

HOGANS, DAVID L

ART UNIT	PAPER NUMBER
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2813

DATE MAILED: 07/31/2002

7

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/988,685

Applicant(s)

SHIOYA ET AL.

Examiner

David L. Hogans

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 27 June 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-25 is/are pending in the application.
- 4a) Of the above claim(s) 9-11 and 14-25 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-8, 12 and 13 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 20 November 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s) _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Election/Restrictions

1. Claims 9-11 and 14-25 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim. Election was made **without** traverse in Paper No. 6.
2. Claims 12 and 13 were deemed as includable in Group 1.

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in–

(1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effect under this subsection of a national application published under section 122(b) only if the international application designating the United States was published under Article 21(2)(a) of such treaty in the English language; or
(2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that a patent shall not be deemed filed in the United States for the purposes of this subsection based on the filing of an international application filed under the treaty defined in section 351(a).

2. Claims 1, 4, 6-7 and 13 are rejected under 35 U.S.C. 102(e) as being anticipated by 6,417,092 to Jain et al.

Claim 1

In reference to Claim 1, Jain et al. teaches:

- a plasma gas that contains nitrogen (See column 3 lines 10-15)

- exposing a copper layer to the plasma gas so as to create a diffusion preventing layer (See column 2 lines 58-66; column 3 lines 9-15; column 3 lines 58-65)

Claim 4

In reference to Claim 4, Jain et al. teaches:

- a plasma gas that contains nitrogen and ammonia (See column 3 lines 10-15)
- exposing a copper layer to the plasma gas so as to create a diffusion preventing layer (See column 2 lines 58-66; column 3 lines 9-15; column 3 lines 58-65)

Claims 6 and 13

In reference to Claims 6 and 13, Jain et al. teaches:

- a silicon oxide layer grown over the reformed copper layer (See column 4 lines 10-23)

Claim 7

In reference to Claim 6, Jain et al. teaches:

- exposing the silicon oxide layer to a plasma gas containing nitrogen and ammonia (See column 3 lines 10-15 and column 4 lines 58-64); or
- forming a silicon insulating film simultaneously with a plasma gas containing nitrogen and ammonia (See column 3 lines 9-15)

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3. Claim 1 is rejected under 35 U.S.C. 102(e) as being anticipated by 6,174,810 to Islam et al.

In reference to Claim 1, Islam et al. teaches:

- a plasma gas that contains nitrogen (See column 3 lines 52-57)
- exposing a copper layer to the plasma gas so as to create a diffusion preventing layer (See column 3 lines 62-66)

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 2, 3 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over 6,417,092 to Jain et al.

Claims 2 and 3

- an alkylsilane such as tetramethylsilane and methylsilane (See column 3 lines 9-15) (Examiner notes these compounds incorporate silicon but silicon being within the same periodic column as carbon exhibits analogous chemical characteristics. Furthermore, the compounds contain hydrogen and carbon.)

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Claim 13

- a SiCHN insulating film formed while the copper layer was being reformed (See column 3 lines 9-15)

6. Claims 5 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over 6,417,092 to Jain et al. in view of 6,174,810 to Islam et al.

Claim 5

Incorporating all arguments of Claim 1 and noting that Jain et al. fails to teach a ammonia plasma process by itself.

However, Islam et al., in column 3 lines 35-53, teaches a silicon free plasma gas that only contains ammonia. Furthermore, Islam et al. teaches that the nitrogen in the plasma assists in the reduction of copper oxide on the copper surface. (See column 3 lines 62-66)

It would have been obvious to one of ordinary skill in the art to modify Jain et al. in view of Islam et al. teachings of a silicon free plasma gas that only contains ammonia. Jain's et al. modification via Islam's et al. teachings is obvious because the nitrogen in the plasma assists in the reduction of copper oxide on the copper surface.

Claim 8

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Incorporating all arguments of Claim 6 and noting that Jain et al. teaches forming an insulating film (16) on the silicon containing insulating film (15), forming a via hole in the insulating film, burying a plug and forming an upper wiring electrically connecting the plug. (See Figures 1a-1h, column 3 lines 9-15 and column 4 lines 15-65)

Jain et al. fails to explicitly teach wherein the via hole is formed through the silicon insulating film.

However, Islam et al., in column 6 lines 20-25, teaches removal of the copper barrier layer/silicon insulating film (40) to expose the underlying copper layer. Furthermore, Islam et al. teaches that these via's are then filled to form interconnects. (See column 6 lines 30-50)

It would have been obvious to one of ordinary skill in the art to modify Jain et al. in view of Islam et al. teachings of removal of the copper barrier layer (40) to expose the underlying copper layer. Jain's et al. modification via Islam's et al. teachings is obvious because these via's are then filled to form interconnects.

7. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over 6,417,092 to Jain et al. in view of 6,174,810 to Islam et al. further in view of 6,277,733 to Smith.

Incorporating all arguments of Claim 8 and noting that Jain et al. and Islam et al. fail to explicitly teach a insulating film comprised by either FSG or porous silicon dioxide.

However, Smith, in column 3 lines 25-30, teaches an insulating film comprised by FSG. Furthermore, Smith teaches one would employ FSG during a damascene process because it has a low dielectric constant.

It would have been obvious to one of ordinary skill in the art to modify Jain et al. and Islam et al. in view of Smith's teachings of an insulating film comprised by FSG. Jain's et al. and Islam's et al. modification via Smith's teachings is obvious because one would employ FSG during a damascene process because it has a low dielectric constant.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to David L. Hogans whose telephone number is (703) 305-3361. The examiner can normally be reached on M-F (7:30-4:30).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on (703) 306-2794. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7724 for After Final communications.

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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-1782.

C. Chaudhari

Chandra Chaudhari
Primary Patent Examiner

dh *dh*
July 26, 2002